



1 insulation tape is cut along the parallel lines where sprocket holes arrange on to become  
2 several strips of small flexible circuit tapes with variable width, then reeled in reels.  
3 Therefore, it is possible to massively produce tape type flexible printed circuits with low  
4 cost and with variable width by means of a set of manufacturing system.

5 In accordance with the process for massively producing tape type flexible printed  
6 circuits, a copper foil and a dry film are sequentially bonded on a flexible insulation tape  
7 which is made of polyimide, polyester, polyethylene naphthalate, liquid crystal polymer,  
8 or Teflon in reel-to-reel fashion, and a first standard point is set on the flexible insulation  
9 tape. Thereafter, the copper foil is etched to form metal traces, and sequentially cover  
10 films are attached on the flexible insulation tape. Then surface treating is executed. Next,  
11 the sprocket holes are formed on the flexible insulation tape by punching and the flexible  
12 insulation tape is cut along the parallel lines where the sprocket holes arrange on to  
13 become several strips of narrow flexible circuit tapes, then reeled in reels. Each flexible  
14 circuit tape has a plurality of flexible printed circuits between two sides of sprocket holes.  
15 It is preferable that there is an electrical test step right after cutting step for testing the  
16 flexible printed circuits and marking the defectives.

## 17 DESCRIPTION OF THE DRAWINGS

18 Fig.1 is a process flowchart for massively producing tape type flexible printed  
19 circuits in accordance with the present invention.

20 Fig.2 is a three-dimensional diagram showing a provided flexible insulation tape  
21 reeled on a reel in accordance with the process for massively producing tape type flexible  
22 printed circuits of the present invention.

23 Fig.3a is a side view showing the flexible insulation tape in the step of sequentially  
24 pressing a copper foil in accordance with the process for massively producing tape type  
25 flexible printed circuits of the present invention.

26 Fig.3b is a side view showing the flexible insulation tape in the step of sequentially  
27 pressing a dry film in accordance with the process for massively producing tape type

1 flexible printed circuits of the present invention.

2 Fig.4 is a side view showing the flexible insulation tape in the step of developing in  
3 accordance with the process for massively producing tape type flexible printed circuits of  
4 the present invention.

5 Fig.5 is a side view showing the flexible insulation tape in the step of etching in  
6 accordance with the process for massively producing tape type flexible printed circuits of  
7 the present invention.

8 Fig.6 is a side view showing the flexible insulation tape in the step of attaching  
9 cover films on in accordance with the process for massively producing tape type flexible  
10 printed circuits of the present invention.

11 Fig.7 is a side view showing the flexible insulation tape in the step of surface  
12 treating in accordance with the process for massively producing tape type flexible printed  
13 circuits of the present invention.

14 Fig.8 is a front view showing the flexible insulation tape in the step of punching and  
15 cutting in accordance with the process for massively producing tape type flexible printed  
16 circuits of the present invention.

17 Fig.9 is a cross-sectional view of manufactured tape type flexible printed circuits in  
18 accordance with the process for massively producing tape type flexible printed circuits of  
19 the present invention.

## 20 DETAILED DESCRIPTION OF THE PRESENT INVENTION

21 Referring to the drawings attached, the present invention will be described by means  
22 of the embodiments below.

23 Fig.1 shows a flowchart of a process for massively producing tape type flexible  
24 printed circuits of the present invention. A flexible insulation tape in the flowing  
25 procedures is shown from Fig.2 to Fig.8.

26 As shown in Fig.1, the process for massively producing tape type flexible printed  
27 circuits of the present invention comprises: step (a) of “providing a flexible insulation

tape”, step (b) of “sequentially pressing a copper foil and a dry film”, step (c) of “developing the dry film”, step (d) of “etching the copper foil”, step (e) of “sequentially attaching cover films”, step (f) of “surface treating”, step (g) of “punching to form sprocket holes and cutting the flexible insulation tape”, and step (h) of “electrically testing”.

As shown in Fig.2 in the step (a) of “providing a flexible insulation tape”, a flexible insulation tape 20 that is reeled in a reel 11 is prepared. The flexible insulation tape 20 is made of polyimide (PI), Polyether (that is polyethylene terephthalate (PET)), polyethylene naphthalate (PEN), liquid crystal polymer (LCP), or Teflon. In this embodiment the flexible insulation tape 20 is a polyimide film and has a thickness about 10~75  $\mu\text{m}$ , usually it is 25  $\mu\text{m}$  approximately.

The step (b) of “sequentially pressing a copper foil and a dry film” is shown in Fig.3a and 3b. As shown in Fig.3a, at first the flexible insulation tape 20 is reeled out from a reel 11 and reeled in another reel 11. The copper foil 30 is also reeled out from a reel, then sequentially pressed on the flexible insulation tape 20 by a laminator 12 between two reels 11 so that the flexible insulation tape 20 with copper foil 30 is reeled in another reel 11. The thickness of the copper foil 30 is about 5~40  $\mu\text{m}$ , usually it is 18  $\mu\text{m}$  approximately. Thereafter as shown in Fig.3b, the flexible insulation tape 20 with copper foil 30 is reeled out from a reel 11 again and sequentially presses a dry film 40 by a laminator 12. The dry film 40 is a kind of photoimagible film such as positive photoresist or negative photoresist. The flexible insulation tape 20 with copper foil 30 and dry film 40 is reeled in a reel 11 after pressing step (b). During pressing, it is better to set a plurality of first standard points 21 at the flexible insulation tape 20, such as punching through holes, for positioning the flexible insulation tape 20 in following steps. In another embodiment, the flexible insulation tape 20 with copper foil 30 may be provided directly from supplier, it is only needed to press the dry film 40 during the pressing step (b).

1        In the step (c) of "developing the dry film", as shown in Fig.4, according to the first  
2        standard points 21 the flexible insulation tape 20 is reeled out to a suitable location and  
3        length, then the dry film 40 is developed to form a patterned dry film 41. Due to the first  
4        standard points 21 for positioning, the step (c) is executed repeatedly so that there is a  
5        fixed interval between each developed portion and adjacent developed portion on the  
6        flexible insulation tape 20 and each developed portion is one by one and neatly arranged  
7        without declination.

8        As shown in Fig.5, in the step (d) of "etching the copper foil", the flexible insulation  
9        tape 20 with patterned dry film 41 is reeled out and etched. By means of copper chloride  
10       etching liquid, the portions uncovered by the patterned dry film 41 are etched to make the  
11       copper foil 30 form metal traces 31 for electrical connection. Thereafter, the patterned dry  
12       film 41 is removed by alkaline liquid for exposing the metal traces 31. Then the flexible  
13       insulation tape 20 is reeled in reel 11 after backing and setting a plurality of second  
14       standard points 22.

15       As shown in Fig.6, in the step (e) of "sequentially attaching cover films", the  
16       flexible insulation tape 20 with metal traces 31 is reeled out and a plurality of cover films  
17       50 are sequentially attached on the flexible insulation tape 20 with determined pressure.  
18       The cover films 50 are made of insulation materials such as polyimide, polyester, PEN, or  
19       LCP and have a thickness about 10~75  $\mu$  m, usually it is 25  $\mu$  m approximately. The cover  
20       films 50 have hollow portions 53 and standard holes 52 in advance. During attaching the  
21       standard holes 52 of the cover films 50 are pointed to the second standard points 22 of  
22       flexible insulation tape 20, the cover films 50 are combined to become a cover layer 51  
23       on the flexible insulation tape 20 for protecting the metal traces 31 and exposing  
24       connection terminals of the metal traces 31. Alternatively, the cover layer 51 also can be  
25       a solder mask formed by mask printing or mask spraying, wherein the solder mask is a  
26       liquid photoimaging solder mask. Executing a developing step for the solder mask is  
27       necessary to form hollow portions 53 of the cover layer 51.

1       As shown in Fig.7, in the step (f) of “surface treating”, the treatments of  
2       electroplating, tin paste printing, heat resistance, and anti-rust are executed on the flexible  
3       insulation tape 20 with cover layer 51 to make the exposed ends of metal traces 31 form  
4       an electroplating layer 32 or protruding electrodes, etc. The electroplating layer 32 is  
5       formed by non-electrolysis electroplating, gold electroplating, or tin-lead electroplating  
6       method. Also the flexible insulation tape 20 is reeled in a reel 11 after completing the step  
7       (f) of “surface treating”. Preferably, from step (b) to step (f) are repeated until enough  
8       layers of the metal traces are formed on the flexible insulation tape 20.

9       The step (g) of “punching to form sprocket holes and cutting the flexible insulation  
10      tape” is shown in Fig.8. The flexible insulation tape 20 passing the step (f) of surface  
11      treating is reeled out and punched to form a plurality of sprocket holes 61 which arrange  
12      on a plurality of parallel lines at even number. In this embodiment, the flexible insulation  
13      tape 20 is wide enough to arrange three rows of tape type flexible printed circuits 62. The  
14      sprocket holes 61 are formed at the two sides of each row of the tape type flexible printed  
15      circuits 62. Then, the flexible insulation tape 20 is cut along parallel lines 23 parallel to  
16      where the sprocket holes 61 arrange on by cutting or punching method, so that the  
17      flexible insulation tape 20 is divided to several narrow flexible circuit tapes 60 and reeled  
18      in the reels 13. Besides, each flexible circuit tape 60 has a plurality of tape type flexible  
19      printed circuits 62 with two rows of sprocket holes 61. After the flexible circuit tapes 60  
20      are formed, it is preferable to execute step (h) of “electrically testing” for testing the  
21      flexible circuit tapes 60 and marking the defective tape type flexible printed circuits 62.  
22      Usually marking holes are formed on/around the defective tape type flexible printed  
23      circuits 62 for distinction without separating or getting rid of defectives. Finally, the  
24      known-good completed tape type flexible printed circuits 62 and the marked defectives  
25      are reeled in the reels 13.

26      According to the process for massively producing tape type flexible printed circuits  
27      mentioned above, several winds of flexible circuit tapes 60 with single-layer circuits can

1 be manufactured simultaneously. The cross-sectional structure of tape type flexible  
2 printed circuits 62 is shown as Fig.9. The process is not only to provide a massive  
3 production of tape type flexible printed circuits 62, but also can manufacture various  
4 width of flexible circuit tapes 60 having tape type flexible printed circuits (such as 35mm,  
5 48mm, 70mm for width) by means of a same set of producing equipment only. When a  
6 wider or narrower tape type flexible printed circuits 62 are going to be manufactured, a  
7 flexible insulation tape 20 having a width about 250mm is provided to execute the step  
8 (b) of "sequentially pressing a copper foil and a dry film", the step (c) of "developing  
9 the dry film", the step (d) of "etching the copper foil", the step (e) of "sequentially  
10 attaching cover films", and the step (f) of "surface treating", etc. Next in the step (g) of  
11 "punching to form sprocket holes and cutting the flexible insulation tape", the cutting  
12 paths should be changed to form the flexible circuit tapes with appropriate width. ( for  
13 example, a provided flexible insulation tape having a thickness about 250mm can be  
14 divided to 3 reels for width 70mm, 4 reels for width 48mm or 5 reels for width 35mm of  
15 flexible circuit tapes 60). Therefore, the present invention can massively manufacture  
16 various kinds of standard width of tape type flexible printed circuits 62 by a same set of  
17 producing equipment so as to reach the effects of massive production and elastical  
18 manufacture. Besides, completed flexible circuit tapes 60 are reeled in reels 13 not only  
19 to keep the packaging cost low but also to provide customers an automatic assembly.

20 As shown in Fig.9 in accordance with the process for massively producing tape type  
21 flexible printed circuits 62 mentioned above, completed tape type flexible printed circuits  
22 62 includes a flexible insulated layer 64 which is made of polyimide, polyester,  
23 polyethylene naphthalate, liquid crystal polymer, or Teflon. The flexible insulated layer  
24 64 has a thickness about 10 ~75  $\mu\text{m}$ , also a plurality of metal traces 31 and a cover layer  
25 51 are formed thereon (for example, adhesive 63 adhering copper foil, or a copper foil is  
26 directly pressed on the flexible insulated layer 64 with non-solidifying condition). The  
27 metal layer 31 has a thickness about 5~40  $\mu\text{m}$  and the thickness of the cover layer 51 is

1 10~75  $\mu\text{m}$  approximately, so the entire thickness of tape type flexible printed circuits 62  
2 is thinner than 0.2mm. The metal traces 31 have electroplating layers 32 or protruding  
3 electrodes at the hollow portion 53 of protective layer 51. Therefore, the tape type  
4 flexible circuits board 62 that can be massively produced is extremely suitable for  
5 electrically connecting, such as connecting display panel and printed circuit board, and  
6 widely applied to LCD display, notebook computer, PDA and cell telephone, etc, even  
7 being chip carrier of semiconductor package.

8 Besides, according to the process for massively producing tape type flexible printed  
9 circuits of the present invention, the step (b) of “sequentially pressing a copper foil and  
10 a dry film”, the step (c) of “developing the dry film”, the step (d) of “etching the copper  
11 foil”, the step (e) of “sequentially attaching cover films”, and the step (f) of “surface  
12 treating” are repeatedly executed until enough layers of metal traces 31 are formed on the  
13 flexible insulation tape 20. Thereafter, several winds of flexible circuit tapes with  
14 multi-layer circuit structure may be manufactured after completing the step (g) of  
15 “punching to form sprocket holes and cutting the flexible insulation tape” and the step (h)  
16 of “electrically testing”.

17 The above description of embodiments of this invention is intended to be illustrated  
18 and not limiting. Other embodiments of this invention will be obvious to those skilled in  
19 the art in view of the above disclosure.